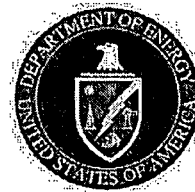


# Rocky Flats Environmental Technology Site Proposed Plan

Jefferson County, Colorado



## DOE Announces the Proposed Plan for the Rocky Flats Environmental Technology Site

July 2006

### THE PROPOSED PLAN INCLUDES:

- Purpose of the Proposed Plan
- Remedial Investigation/Feasibility Study
- Site Background and History
- Site Regulatory Framework
- History of Public Participation Activities
- Site Characteristics
- Summary of Site Risks
- Contaminant Fate and Transport
- Scope and Role of OUs
- Key Conclusions of the Remedial Investigation
- Summary of Remedial Action Objectives
- Summary of Remedial Alternatives
- Comparison of Alternatives
- Proposed Remedy

### Purpose of the Proposed Plan

This Proposed Plan identifies the U.S. Department of Energy's (DOE's) preferred final remedy for the Rocky Flats Environmental Technology Site (Rocky Flats or the site) and provides the rationale for the preference. The preferred alternative for the Central Operable Unit is institutional and physical controls. No action is proposed for the Peripheral Operable Unit.

The purpose of the Proposed Plan is to provide the public with a reasonable opportunity to comment on the proposed remedy, as well as alternative plans under consideration, and to participate in the selection of the remedy. The proposed remedy can change in response to public comment or new information. The final remedy decision will be documented in the *Corrective Action Decision/Record of Decision (CAD/ROD)*.<sup>1</sup>

### MARK YOUR CALENDAR!

#### Public comments on the Proposed Plan will be received at the Public Hearing:

Date: Thursday, August 31, 2006  
Time: 3:00 – 5:00 p.m. with a one-hour break, returning from 6:00 – 9:00 p.m.  
Location: Arvada Center Ballrooms C&D, 6901 Wadsworth Blvd., Arvada

#### Send comments on the Proposed Plan to:

U.S. Department of Energy, Attention: Proposed Plan Comments  
Rocky Flats Environmental Technology Site  
12101 Airport Way, Unit A, Broomfield, CO 80021-2583

Comments must be postmarked by: **September 13, 2006**

You may also email your comments to: [comments@rf.doe.gov](mailto:comments@rf.doe.gov)

Please attend one of our informational public meetings to learn about the Proposed Plan:

#### Informational Meeting #1

Date: Wednesday, July 19, 2006  
Time: 6:00 – 9:00 p.m.  
Location: Jefferson County Fairgrounds  
Green Mountain Conference Room A  
15200 W. 6th Ave., Golden

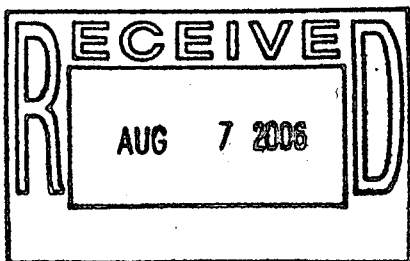
#### Informational Meeting #2

Date: Tuesday, August 8, 2006  
Time: 6:00 – 9:00 p.m.  
Location: Westminster City Park  
Community Room  
10455 Sheridan Blvd., Westminster

This Proposed Plan fulfills public participation requirements under the *Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)* Section 117, prior to selection of a final remedy. The Proposed Plan also fulfills the public participation requirements of the *Resource Conservation and Recovery Act (RCRA)* and the *Colorado Hazardous Waste Act (CHWA)* for selection of the final remedy and corrective action.

ADMIN RECORD

<sup>1</sup> Terms in italics are defined in the Glossary.



## Remedial Investigation/Feasibility Study

In addition to the Proposed Plan, the public is encouraged to consult the RCRA Facility Investigation (RFI)-Remedial Investigation (RI)/Corrective Measures Study (CMS)-Feasibility Study (FS) Report for Rocky Flats. This report is referred to as the RI/FS Report.

The RI/FS Report presents detailed information about the history and physical setting of Rocky Flats, the results of the investigation of hazardous substance releases conducted at Rocky Flats, and the detailed analysis of alternatives. Remedial activities at Rocky Flats are being conducted under CERCLA, as well as RCRA and CHWA. The RI/FS meets the requirements of all of these laws.

To complete the cleanup and closure mission, a final CERCLA and RCRA/CHWA remedial decision based on levels of hazardous substances remaining at the site is required. The approved RI/FS Report is the basis for development of this Proposed Plan describing the preferred remedy for Rocky Flats.

The Proposed Plan is the basis for the final CAD/ROD.

The RI/FS Report is organized as follows:

- Section 1.0 presents introductory information, including the site background, site description, history, future land use, previous investigations, and regulatory approach for cleanup.
- Section 2.0 presents a summary of the physical characteristics of the site, including surface features, meteorology, surface water hydrology, geology, soil, hydrogeology, demography and land use, and ecology.
- Sections 3.0 through 6.0 present the nature and extent of soil, groundwater, surface water and sediment, and air contamination, respectively.
- Section 7.0 presents the summary and conclusions of the Comprehensive Risk Assessment (CRA). The CRA consists of a Human Health Risk Assessment (HHRA) and an Ecological Risk Assessment (ERA).
- Section 8.0 presents contaminant fate and transport and describes potential routes of migration based on the RFETS conceptual model, physical characteristics of the site, contaminant mobility, and environmental persistence.
- Section 9.0 presents the summary and conclusions of the RI. Sections 1.0 through 9.0 comprise the Remedial Investigation.

## YOU ARE ENCOURAGED TO REVIEW THE RI/FS REPORT

The RI/FS Report is available for review at each of the Information Centers listed below, as well as online at [www.rfets.gov](http://www.rfets.gov), or by contacting Bob Darr at 303-966-4546.

The Rocky Flats Administrative Record files containing the documents that form the basis for site decisions are available online through the CERCLA Administrative Record link in the General Information section of [www.rfets.gov](http://www.rfets.gov).

### INFORMATION CENTERS

The Information Centers where copies of the Proposed Plan and the RI/FS Report are available for viewing are:

**Front Range Community College  
College Hill Library**  
3075 W. 112th Ave.  
Westminster, CO  
303-404-5504

**(The Rocky Flats CERCLA  
Administrative Record file is also  
available at this location.)**

**Colorado Department of Public Health &  
Environment  
Hazardous Materials and Waste  
Management Division  
Records Center**  
4300 Cherry Creek Dr. South  
Denver, CO  
303-692-3300

**University of Colorado  
Government Publications  
Norlin Library**  
Boulder, CO  
303-492-8705

**Boulder Public Library - Main Branch**  
1000 Canyon Blvd.  
Boulder, CO  
303-441-3100

**Standley Lake Library**  
8485 Kipling St.  
Arvada, CO  
303-456-0806

**Mamie Dowd Eisenhower Public  
Library**  
3 Community Park Rd.  
Broomfield, CO  
720-887-2300

**U.S. Environmental Protection Agency  
Region 8 Technical Library**  
1st Floor in the EPA Information Center  
999 18th St.  
Denver, CO  
303-312-7226

- Sections 10.0 and 11.0 present the Feasibility Study. Section 10.0 presents the *remedial action objectives* (RAOs) and the *applicable or relevant and appropriate requirements* (ARARs) used for remedial alternatives. Section 11.0 presents a detailed analysis of remedial alternatives.
- Appendix A contains the CRA Report (Volumes 1 through 15).
- Appendix B contains the 2005 Historical Release Report (HRR).

## Site Background and History

Rocky Flats is a 6,240-acre DOE facility owned by the United States. Rocky Flats is located in the Denver metropolitan area, approximately 16 miles northwest of Denver, Colorado, and approximately 10 miles south of Boulder, Colorado (please refer to Figure 1).

Rocky Flats was established in 1951 as part of the United States' nationwide nuclear weapons complex to manufacture nuclear weapons components from various *radioactive* and hazardous materials. Other support activities included chemical recovery and purification of recyclable transuranic radionuclides and research and development in metallurgy, machining, nondestructive testing, coatings, remote engineering, chemistry, and physics. From 1951 until 1992, DOE and its contractors managed and operated Rocky Flats under authorization of the *Atomic Energy Act* (AEA). Manufacturing activities, accidental industrial fires and spills, and support activities including waste management resulted in the release of *hazardous substances*, *hazardous wastes*, and hazardous waste constituents to air, soil, sediment, groundwater, and surface water at Rocky Flats.

The majority of Rocky Flats structures were located within an approximately 300-acre industrialized area at the center of the property. The *industrial area* was surrounded by a security *buffer zone*, which contained some supporting activities, such as waste disposal, but was left mostly undisturbed.

Some buildings and infrastructure systems became contaminated. Leaking storage drums, unlined disposal trenches, surface water impoundments, and leaking underground tanks contributed to the contamination of soils at the site.

Contaminants released to the environment include (but are not limited to) *plutonium-239/240*, *americium-241*, *uranium*, carbon tetrachloride, tetrachloroethene (PCE or Perc), trichloroethene (TCE), nitrates, and chromium.

Volatile organic compounds (VOCs), nitrate, and uranium contaminated shallow groundwater. The radioactive elements plutonium, uranium, and americium contaminated soils. The potential for radioactive particles on soil to become airborne during strong winds or to be transported to streams were a concern.

Since 1992, when weapons production halted, the Rocky Flats mission has included the safe storage and shipment of *special nuclear material*, nuclear deactivation and decommissioning, waste management and shipment, environmental investigations, cleanup, and site closure. When cleanup is complete, portions of the site will be transitioned to a National Wildlife Refuge. Potential future users of the wildlife refuge include wildlife refuge workers (WRWs) and wildlife refuge visitors (WRVs).

## Site Regulatory Framework

Results of early environmental investigations indicated that operations at Rocky Flats resulted in the release of materials defined by CERCLA as hazardous substances, contaminants, and pollutants, as well as hazardous wastes and waste constituents as defined by RCRA. The U.S. Environmental Protection Agency (EPA) proposed Rocky Flats for inclusion on the *CERCLA National Priorities List* in 1984 and the listing became final in 1989.

Under CERCLA, the responsibility for the response action for hazardous substance releases at Rocky Flats has been delegated to DOE as the Lead Agency in accordance with Executive Order 12580. EPA and the Colorado Department of Public Health and Environment (CDPHE) are the Support Agencies. Under RCRA/CHWA, DOE is the facility permittee and responsible for corrective action for releases of hazardous waste and hazardous waste constituents, which are also CERCLA hazardous substances, at Rocky Flats. In Colorado, RCRA/CHWA corrective action is regulated by CDPHE.



Investigation and cleanup activities have been formally covered under three successive federal facility agreements and compliance orders, beginning in 1986 and culminating with the *Rocky Flats Cleanup Agreement (RFCA)* signed by DOE, EPA, and CDPHE in July 1996.

DOE activities under RFCA are regulated by CERCLA, RCRA, CHWA, their implementing regulations, and other applicable environmental laws. DOE is responsible for satisfying the requirements of the agreement.

RFCA integrates the complex regulatory requirements for Rocky Flats into a single regulatory agreement. The agreement coordinates DOE's obligations and EPA's and CDPHE's respective statutory authorities for planning, approving, and conducting cleanup work and for selecting and approving the final CERCLA response action in a ROD and the final RCRA/CHWA corrective action in a CAD.

To expedite remedial work and maximize early risk reduction, RFCA adopted an accelerated action approach to cleanup, equivalent to the removal authority found in CERCLA. DOE used accelerated actions to remove contaminated soils, decontaminate and demolish contaminated buildings, close two landfills and install groundwater treatment systems. All accelerated action decision documents went through public review and comment and were approved by EPA and CDPHE.

As part of the investigation and cleanup process under RFCA, 421 known or suspected release locations, referred to as *Individual Hazardous Substance Sites (IHSSs)*, were thoroughly investigated and characterized. All historical IHSSs were dispositioned in accordance with RFCA requirements. The disposition process resulted in either an accelerated action or a determination that no further action was required. All planned accelerated actions were implemented and confirmed completed by EPA and CDPHE by May 2006.

Information on historical IHSSs is summarized in the HRR (Appendix B of the RI/FS Report). The RI/FS Report also provides information about the extensive sampling and monitoring programs and actions that have been taken. Approximately 1.9 million analytical records exist in the sitewide RI/FS data set. Monitoring has included:

- Environmental monitoring for water and air radionuclide contamination.
- Groundwater and surface water hazardous substance contamination has been investigated on a sitewide basis including both routine regulatory compliance monitoring and targeted sampling of contaminated areas.
- Since 1996, groundwater and surface water monitoring programs have been conducted in accordance with the *RFCA Integrated Monitoring Plan (IMP)*.
- Air quality was monitored routinely, including regulatory compliance monitoring to meet Clean Air Act requirements and targeted sampling during cleanup.

Under RCRA/CHWA, DOE is required to collect and present all information necessary for the individual release sites, including sources of contamination, to characterize each release and evaluate potential risks to human health and the environment. Releases from *Solid Waste Management Units (SWMUs)* must be addressed to protect human health and the environment.

In accordance with the Rocky Flats National Wildlife Refuge Act of 2001, Public Law (P.L.) 107-107 (Refuge Act), the future use of portions of Rocky Flats is as a wildlife refuge. The U.S. Fish and Wildlife Service (USFWS), an agency of the U.S. Department of Interior, will assume jurisdiction and control of most of the property for refuge purposes. DOE will retain jurisdiction of real property and facilities to be used in carrying out any final response action.

### History of Public Participation Activities

Because of its role in the manufacture of nuclear weapons components and well publicized concerns over several industrial fires and accidents resulting in the release of radioactive constituents, Rocky Flats has been the subject of strong public interest for more than 30 years.

In response to early public interest about Rocky Flats issues, Gov. Richard Lamm and Rep. Timothy Wirth appointed the Lamm-Wirth Task Force on Rocky Flats in December 1974. The task force was charged with developing information to help the governor and congressman understand and deal with Rocky Flats operations.

## MAJOR ACCOMPLISHMENTS COMPLETED UNDER RFCA

<p>Approximate amount of special nuclear material shipped to other DOE facilities:</p> <ul style="list-style-type: none"> <li>• 21 tons of weapons-grade material (includes plutonium and highly enriched uranium)</li> <li>• 100 tons of plutonium residues</li> <li>• 30,000 liters of special nuclear material solutions</li> </ul>	<p>Over 800 structures cleaned up/removed, including more than 1 million square feet (ft<sup>2</sup>) associated with:</p> <ul style="list-style-type: none"> <li>• 5 major plutonium facilities</li> <li>• 2 major uranium facilities</li> </ul>
<p>1,475 gloveboxes deactivated, decontaminated, removed, and size-reduced, as required, and disposed offsite.</p>	<p>690 tanks deactivated, decontaminated, removed, and size-reduced, as required, and disposed offsite.</p>
<p>Covers installed at the Present Landfill and Original Landfill to meet applicable or relevant and appropriate landfill regulatory closure performance criteria.</p>	<p>421 IHSSs, PACs, UBC Sites, and PICs investigated and dispositioned.</p> <p>All RFCA accelerated cleanup actions have been completed or a No Further Accelerated Action (NFAA) decision was made.</p>
<p>Three contaminated groundwater systems and one seep collection system and accompanying treatment systems installed that serve to protect surface water quality.</p> <ul style="list-style-type: none"> <li>• Over 11 million gallons of contaminated groundwater and 5 million gallons of contaminated seep water treated to date</li> </ul>	<p>Cleanup and closure waste shipped offsite including contaminated soils:</p> <ul style="list-style-type: none"> <li>• Over 15,000 cubic meters (m<sup>3</sup>) transuranic waste (including mixed waste)</li> <li>• Over 500,000 m<sup>3</sup> low-level radioactive waste (including mixed waste)</li> <li>• Over 800,000 m<sup>3</sup> sanitary waste</li> <li>• Over 4,300 m<sup>3</sup> hazardous waste</li> </ul>

In 1987, Gov. Roy Romer and Rep. David Skaggs appointed the Rocky Flats Environmental Monitoring Council. The Council was a citizen's advisory committee to provide communications between the public, DOE, DOE's site contractor, and the regulatory agencies regarding environmental, safety, public health, and regulatory compliance issues, as well as act as an advisory body to the governor and congressman. The group was renamed the Colorado Council on Rocky Flats (CCRF) in August 1992.

In 1992, the Federal Facilities Environmental Restoration Dialogue Committee was federally chartered under EPA to address the concerns expressed by a wide range of stakeholders associated with federal facilities. The committee published an interim report in February 1993 that led to DOE sites setting up site-specific advisory boards. As a result, the Rocky Flats Citizens Advisory Board (RFCAB) formed in the summer of 1993. The RFCAB mission has been to provide independent, community-based recommendations on the Rocky Flats cleanup. RFCAB effectively replaced the CCRF. RFCAB disbanded in June 2006.

The Rocky Flats Local Impacts Initiative (RFLII) formed as a coalition of local governments, business organizations, and other interested parties in the summer of 1991. The group's interests were worker

and community transition, downsizing, economic development, future land use, and related areas. RFLII served until the end of March 1999.

The Rocky Flats Coalition of Local Governments (RFCLOG) succeeded RFLII in April 1999. RFCLOG was composed of seven local governments surrounding Rocky Flats. The group carried forward with RFLII's interests as well as the cleanup, worker safety and health, and stewardship after site closure. RFCLOG with other stakeholders transitioned into the Rocky Flats Stewardship Council in March 2006. The council will provide a forum for continued local government and citizen interest in Rocky Flats future stewardship. Many non-governmental organizations have also been closely involved in the site's cleanup and closure.

The effort to inform and involve the many Rocky Flats stakeholders resulted in many public meetings to receive formal comments on the large number of interim actions the site carried out under CERCLA and RCRA/CHWA. In addition to special public meetings, regular meetings of RFCAB and RFCLOG provided forums to inform the public and receive comments on site actions.

The public meetings have been augmented by ongoing working group and other informal public meetings. Working groups brought together DOE, the regulatory agencies, local governments, site

contractors, interest groups, and citizens for more specific and in-depth dialogue on many issues. A key working group was the Health Advisory Panel (HAP) on Rocky Flats under the direction of CDPHE. The HAP task force oversaw the Historical Public Exposures Studies on Rocky Flats and an important sampling program in 1993 and 1994 conducted by the Citizens' Environmental Sampling Committee. Another key group was the Radionuclide Soil Action Levels (RSALs) Oversight Panel that was a driving force in revising the action levels for cleanup of radioactively contaminated soils. More groups included the Future Site Use Working Group, the Public Participation Focus Group, the RFCA Stakeholder Focus Group, the Deactivation and Decommissioning/Environmental Restoration Status Group, the Actinide Migration Evaluation Group, the Integrated Monitoring Plan Working Groups, and the Long-Term Stewardship Working Group. Others dealt with topics such as environmental restoration, environmental media monitoring and data exchange, the Site-Wide Water Balance, and volatile organic compound modeling status and results.

A formal EPA- and CDPHE-approved DOE public participation plan has been implemented since the early 1990s to inform the public about investigation and cleanup activities. Under RFCA, the Rocky Flats Sitewide Integrated Public Involvement Plan is structured to implement RFCA requirements for consultation with local elected officials, government managers, organizations, and citizens in addition to provide for legally required public comment periods. Routine formal and informal presentations to stakeholders and solicitation of comments on virtually all aspects of the cleanup have been standard practice for many years.

Rocky Flats stakeholders have been briefed on the development of the Draft RI/FS Report, which included the development of the alternatives addressed in this Proposed Plan. The Draft RI/FS Report has been available in the Public Reading Rooms and online since October 2005. Public and agency comments on the Draft RI/FS Report have been incorporated into the RI/FS Report, approved by EPA and CDPHE on July 5, 2006.

## Site Characteristics

### Physical Characteristics

The site physical characteristics are summarized in Section 2.0 of the RI/FS Report. Some of the key points are summarized below.

- Most areas of the site have remained relatively undisturbed, allowing them to retain diverse habitat and associated wildlife.
- The primary topographic features at Rocky Flats are the Rock Creek, Walnut Creek, and Woman Creek drainages that traverse the site and flow generally from west to east (Figure 2). Sixteen named retention ponds exist throughout Rocky Flats.
- Five functional channels, designed for a 100-year storm event, were constructed as a best management practice to minimize soil disturbance and were generally placed in areas of existing major surface water drainage features.
- The site is underlain by unconsolidated surficial deposits which, combined with the weathered portion of subcropping bedrock formations, form the upper hydrostratigraphic unit (UHSU). Given the relatively high hydraulic conductivity compared to that of the underlying weathered claystone, the unconsolidated portion of the UHSU is the primary influence on groundwater flow and contaminant transport. Shallow groundwater at Rocky Flats is dominated by the hillslope hydrology and is not hydraulically connected to any groundwater drinking water supply.
- Shallow groundwater impacted by site activities emanates from the former industrial area and discharges to surface water in the drainages upgradient of the terminal ponds.
- The removal of buildings and pavement during site cleanup resulted in decreased runoff and affected site hydrology.

The hydrogeology of Rocky Flats has been thoroughly studied and focused groundwater modeling activities supported evaluation and implementation of accelerated actions. The assessment and conclusions are summarized in the RI/FS Report.



## Nature and Extent of Contamination

In the RI/FS Report, the nature and extent of contamination for soil, sediment, groundwater, surface water, and air were evaluated after completion of the RFCA accelerated actions. Each nature and extent of contamination evaluation identified analytes of interest (AOIs). AOIs are chemicals that have been detected at concentrations that may contribute to the risk to future receptors. The evaluation studied the extent of sitewide contaminants and evaluated which chemicals remained after the accelerated actions.

Table 1 presents a summary of the nature and extent of contamination evaluation in Sections 3.0 through 6.0 of the RI/FS Report. The table shows the nature and extent of AOIs by specific medium and the overall spatial and temporal trends of the AOIs on a sitewide basis.

**Soil and Sediment AOIs** are those analytes that are present with greater than a 1 percent frequency of detection above WRW *preliminary remediation goals* (PRGs). These PRGs are calculated values equivalent

to a *hazard quotient* (HQ) of 0.1 or risk of  $1 \times 10^{-6}$ . The more conservative of the two values is established as the PRG. These risk-based numbers are used for these media because no standards exist for soil or sediment, and the exposure assumptions used for the risk-based levels for WRWs are consistent with the future land use.

**Groundwater AOIs** are those analytes with concentrations greater than surface water standards that form contiguous, mappable plumes. Surface water standards are promulgated in the Colorado Water Quality Control Commission regulations. Comparison to surface water standards is consistent with the RFCA objective of protecting surface water quality.

**Surface Water AOIs** are those analytes that are present with greater than a 1 percent frequency of detection above surface water standards for surface water samples collected since January 1, 2000.

**Air AOIs** are those analytes that represent an ongoing source of potential emissions in the future.

TABLE 1

### Nature and Extent of Contamination

Purpose: Shows the nature and extent of Analytes of Interest by specific medium.

SOIL – Screened Against WRW Preliminary Remediation Goals (PRGs) (Screening methodology, standards, and results are discussed in Section 3.0 of the RI/FS Report.)				
Surface soil	Subsurface soil (0.5-3')	Subsurface soil (3-8')	Subsurface soil (8-12')	Subsurface soil (12-30')
<b>Radionuclides</b>	<b>Radionuclides</b>	<b>Radionuclides</b>	<b>Radionuclides</b>	<b>Radionuclides</b>
Americium-241 Plutonium-239/240 Uranium-233/234* Uranium-235* Uranium-238*		Americium-241* Plutonium-239/240 Uranium-235* Uranium-238*	Plutonium-239/240* Uranium-235* Uranium-238*	
<b>Metals</b>	<b>Metals</b>	<b>Metals</b>	<b>Metals</b>	<b>Metals</b>
Aluminum Arsenic Chromium (Total) Vanadium*	Lead*	Chromium (Total)* Lead*	Chromium (Total)*	
<b>Volatile Organic Compounds (VOCs)</b>	<b>VOCs</b>	<b>VOCs</b>	<b>VOCs</b>	<b>VOCs</b>
		Tetrachloroethene*	Tetrachloroethene*	Tetrachloroethene* Trichloroethene* 1,1,2,2-Tetrachloroethane* Carbon tetrachloride* Chloroform* Methylene chloride*
<b>Semi-Volatile Organic Compounds (SVOCs)</b>	<b>SVOCs</b>	<b>SVOCs</b>	<b>SVOCs</b>	<b>SVOCs</b>
Benzo(a)pyrene Dibenz(a,h)anthracene	Benzo(a)pyrene	Benzo(a)pyrene*	Benzo(a)pyrene	

TABLE 1 (CONTINUED FROM PAGE 9)

SOIL – Screened Against WRW Preliminary Remediation Goals (PRGs) (Screening methodology, standards, and results are discussed in Section 3.0 of the RI/FS Report.)				
Surface soil	Subsurface soil (0.5-3')	Subsurface soil (3-8')	Subsurface soil (8-12')	Subsurface soil (12-30')
Polychlorinated Biphenyls (PCBs)	PCBs	PCBs	PCBs	PCBs
PCB-1254 PCB-1260 Dioxins 2,3,7,8-TCDD TEQ				PCB-1260
GROUNDWATER – Screened Against Surface Water Standards (Screening methodology, standards, and results are discussed in Section 4.0 of the RI/FS Report.)				
Upper Hydrostratigraphic Unit (shallow groundwater)				
Radionuclides	VOCs	Metals	Water Quality Parameters	
Uranium (sum of isotopes)	cis-1,2-Dichloroethene 1,2-Dichloroethane* 1,1-Dichloroethene Benzene* Carbon tetrachloride Chloroform Chloromethane* Methylene chloride Tetrachloroethene Trichloroethene Vinyl chloride	Arsenic (D) Chromium (T) Nickel (D) Nickel (T)	Fluoride Nitrate/Nitrite, as N Sulfate	
Lower Hydrostratigraphic Unit (deep groundwater)				
None				
SURFACE WATER – Screened Against Surface Water Standards (Screening methodology, standards and results are discussed in Section 5.0 of the RI/FS Report)				
Radionuclides	VOCs	Metals	Water Quality Parameters	
Americium-241 Plutonium-239/240 Uranium (sum of isotopes) Gross alpha Gross beta	cis-1,2-Dichloroethene Carbon tetrachloride Chloroform Methylene chloride Tetrachloroethene Trichloroethene Vinyl chloride	Aluminum (D) Beryllium (T) Chromium (T) Lead (T) Nickel (T)	Nitrate/Nitrite, as N	
SEDIMENT – Screened Against WRW PRGs (Screening methodology, standards, and results are discussed in Section 5.0 of the RI/FS Report)				
Radionuclides	Metals	SVOCs		
Americium-241 Plutonium-239/240	Arsenic Chromium	Benzo(a)pyrene		
AIR – Screened Against Air Emission Standards (Screening methodology, standards, and results are discussed in Section 6.0 of the RI/FS Report.)				
Radionuclides				
Americium-241 Plutonium-239/240 Uranium-233/234 Uranium-235 Uranium-238				

\* = Indicates those soil AOIs that have a frequency of detection less than 1 percent above the designated standard or wildlife refuge worker PRG and were retained based on process knowledge that indicates the analyte is associated with Rocky Flats activities (such as uranium).

T = Total

D = Dissolved

### Principal and Low-Level Threat Wastes

Materials constituting principal and low-level threats were addressed during RFCA accelerated actions. The only principal or low-level threat wastes remaining at the site consist of *non-aqueous phase liquids* (NAPLs) in groundwater. Dense solvents (such as tetrachloroethene, trichloroethene, and carbon tetrachloride) can collect on impermeable sediments or bedrock to form a separate phase referred to as *dense non-aqueous phase liquid* (DNAPL) (discussed in Section 8.0 of the RI/FS report). These residual VOC sources and associated downgradient groundwater concentrations will persist in the environment for decades to hundreds of years (even with the source removals that were implemented as accelerated actions).

The residual VOCs were evaluated as part of the Groundwater Interim Measure/Interim Remedial Action (IM/IRA), which considered additional feasible and practicable treatment and removal alternatives in addition to the previously installed groundwater treatment systems. Selected soil removal actions, DNAPL removal, and related enhancements detailed in the Groundwater IM/IRA were completed in 2005. The enhancements were intended to reduce the migration of contaminated groundwater that could impact surface water quality. They are not expected to eliminate groundwater contamination in the short term, but to have a positive long-term impact on groundwater and

surface water quality. Thus, feasible and practicable alternatives to address the known principal and low-level threat wastes have been implemented through the accelerated actions.

### Summary of Site Risks

As part of the RI/FS Report, a Comprehensive Risk Assessment was completed for Rocky Flats. The CRA consists of two parts: an HHRA and an ERA. A risk assessment is an evaluation of various exposure scenarios and potential adverse impacts to human health and the environment that may exist from contaminated environmental media associated with site-related activities. The CRA was designed to provide information to decision makers to help determine the final remedy that is adequately protective of human health and the environment.

For purposes of the Comprehensive Risk Assessment, Rocky Flats was divided into 12 *exposure units* (EUs) for assessing potential risks to human health and terrestrial ecological receptors. The site was also divided into seven *aquatic exposure units* (AEUs) for assessing potential risks to aquatic ecological receptors. A sitewide analysis was also conducted for wide ranging terrestrial receptors. The EUs were designated based on known sources and potential contaminant release patterns to allow areas with similar types of potential contaminants to be evaluated collectively. Other criteria used to designate the EUs included separate watersheds, similar topography, vegetation, expected future land use, and functional areas. Functional areas refer to areas that fall within a size range where future onsite workers would likely spend their time. AEUs were designated to represent separate drainages on the upper and lower portions of a large single drainage.

The outcome of the Comprehensive Risk Assessment is the identification of human health *contaminants of concern* (COCs) and *ecological contaminants of potential concern* (ECOPCs), and the estimated risk posed by each.

### WHAT IS A 'PRINCIPAL THREAT'?

The *National Contingency Plan* (NCP) establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (NCP Section 300.430[a] [1] [iii] [A]). The "principal threat" concept is applied to the characterization of source materials at a CERCLA site. A source material is material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater, surface water, or air, or acts as a source for direct exposure. Contaminated groundwater generally is not considered to be a source material; however, NAPLs in groundwater may be viewed as source material. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained, or would present a significant risk to human health or the environment should exposure occur. The decision to treat these wastes is made on a site-specific basis through a detailed analysis of the alternatives using the nine CERCLA remedy selection criteria. This analysis provides a basis for making a statutory finding that the remedy employs treatment as a principal element.

## Human Health Risk Assessment

CDPHE defines acceptable human health risk as a lifetime excess cancer risk less than  $1 \times 10^{-6}$  from exposure to carcinogenic compounds and/or a hazard quotient less than 1.0 for noncarcinogenic compounds.<sup>2</sup>

Under CERCLA and the *National Contingency Plan*, EPA considers environmental concentrations corresponding to a  $1 \times 10^{-6}$  to  $1 \times 10^{-4}$  cancer risk range and a total noncancer *hazard index (HI)* less than or equal to 1 to be adequately protective of human health.

Two types of risk are calculated: cancer risk and noncancer health effects. The likelihood of any kind of cancer resulting from a CERCLA site is generally expressed as an upper bound probability; for example, a 1 in 10,000 chance is expressed as a risk of  $1 \times 10^{-4}$ . In other words, for every 10,000 people that could be exposed, one extra cancer may occur as a result of exposure to site contaminants. An extra cancer case means that one more person could get cancer than would normally be expected from all other causes. For noncancer health effects, EPA calculates a "hazard index." The key concept here is that a "threshold level" (measured usually as a hazard index of less than 1) exists below which non-cancer health effects are no longer predicted.

The risk management conclusion based on the HHRA identified only one COC within one exposure unit that required further evaluation in the Feasibility Study. The surface soil COC for the Wind Blown Area Exposure Unit (WBEU) is plutonium-239/240 with an estimated cancer risk of  $2 \times 10^{-6}$ .<sup>3</sup> While conditions at Rocky Flats are protective of human health based on the low risk

<sup>2</sup> CDPHE guidance requires evaluation of contaminant concentrations on a Solid Waste Management Unit or release site basis. As discussed in RIFS Report Section 1.2.3, this was implemented at Rocky Flats on an Individual Hazardous Substance Site-by-Individual Hazardous Substance Site basis during the accelerated action process. As noted in RIFS Report Section 1.4.3, by addressing cumulative impacts from multiple release sites, the CRA's exposure unit approach complements, but does not supplant, CHWA's emphasis on individual release sites. Because the parties had anticipated using institutional controls consistent with the anticipated future use of the site, CDPHE determined that a post-remediation analysis of residual risk on a release site basis was not necessary.

<sup>3</sup> The dose estimate for plutonium for the wildlife refuge worker is 0.3 mrem/year and for the wildlife refuge visitor child is 0.2 mrem/year, based on the upper-bound average concentrations across the Wind Blown Area Exposure Unit.

## HUMAN HEALTH RISK AND HOW IT IS CALCULATED

The HHRA evaluates the long-term threats to human health. This is an evaluation of the likelihood of health problems occurring if no cleanup action were taken at a site. To estimate the human health risk at a CERCLA site, a four-step process is used:

Step 1: Analyze Contamination

Step 2: Estimate Exposure

Step 3: Assess Toxicity

Step 4: Characterize Site Risk

Step 1 compares site-specific concentrations to preliminary remediation goals (PRGs) to determine which contaminants are most likely to pose the greatest threat to human health. This results in the identification of contaminants of concern (COCs).

Step 2 considers the different ways that people might be exposed to the contaminants identified and calculates a reasonable maximum exposure (RME) scenario which portrays the highest level of human exposure that could reasonably be expected to occur.

Step 3 uses information on the toxicity of each chemical to assess potential health risks.

Step 4 determines whether site risks are great enough to cause health problems for people at or near the site. The results of the three previous steps are combined, evaluated, and summarized.

presented by this contaminant of concern, the Feasibility Study evaluated removal of surface soil to reduce the residual plutonium-239/240 contamination to below the WRW PRG.

The indoor air pathway was evaluated on a sitewide basis. Volatile organic compounds have been detected in the subsurface in some subsurface soil and groundwater sampling locations of the site. The indoor air inhalation pathway is potentially significant if buildings were constructed in these locations. In locations where there are no exceedances of the volatilization PRGs, the indoor air inhalation pathway is assumed to be insignificant. The results of this assessment were further evaluated in the Feasibility Study.

Contaminated subsurface features remain in the subsurface in the former Industrial Area. These features were not evaluated in the CRA because of the assumption in the CRA that there is no exposure pathway for a wildlife refuge worker given that he or she will not be digging below 8 feet. Consequently, the FS will need to embody this CRA assumption in an *institutional control*.

## Ecological Risk Assessment

The overall risk management goal used in the ERA is the following:

*Site conditions due to residual contamination should not represent significant risk of adverse ecological effects to receptors from exposure to site-related residual contamination.*

The ERA was designed and implemented to determine whether site conditions meet the defined goal, and evaluated both terrestrial and aquatic receptors.

No significant risks were identified for any receptor in any exposure unit. In addition, the high species diversity and continued use of the site by numerous vertebrate species indicate that habitat quality for these species remains acceptable and the ecosystem functions are being maintained. Data collected on wildlife abundance and diversity indicate that wildlife populations are stable and species richness remains high at Rocky Flats. This supports the chemical risk conclusions that no significant risks are predicted for receptor populations.

The AEU assessments indicate that there are no continuing, significant risks to aquatic life from residual ecological contaminants of potential concern due to site-related operations. Overall, the aquatic communities are limited by natural environmental conditions such as low flows and poor habitat characteristic of this area along the

## ECOLOGICAL RISK ASSESSMENT AND HOW IT IS CALCULATED

The ecological risk assessment evaluates if there is significant risk to ecological receptors from exposure to site-related residual contamination. To estimate ecological risk at a CERCLA site, a four-step process is used:

- Step 1: Analyze Contamination
- Step 2: Estimate Exposure
- Step 3: Assess Toxicity
- Step 4: Characterize Site Risk

Step 1 compares site-specific concentrations to *ecological screening levels (ESLs)* to determine which contaminants are most likely to pose the greatest threat to ecological receptors. This results in the identification of ecological contaminants of potential concern.

Step 2 describes the relationships and equations used to estimate how much a given chemical in a given medium is taken up by the receptor via a given exposure route.

Step 3 uses information on the toxicity of each chemical to assess potential ecological risks.

Step 4 defines a range of potential risks to receptors from the ECOPCs. The overall risk is then summarized to determine the sustainability of exposed populations for each receptor group and level of biological organization (that is, individual or population level of protection).

Colorado Front Range. No additional significant risks above what would be expected to be encountered in the natural environment in the vicinity of the site are predicted for the aquatic life receptors evaluated in the Ecological Risk Assessment.

The overall conclusions of the Ecological Risk Assessment indicate that site conditions due to residual contamination do not represent significant risk of adverse ecological effects to receptors from exposure to site-related residual contamination. However, additional surface water, sediment, and ecological monitoring is recommended to address uncertainties identified in the Ecological Risk Assessment.

## Contaminant Fate and Transport

The contaminant fate and transport evaluation used information about the site physical characteristics, contaminant source characteristics, and contaminant distribution across the site to describe how contaminants could migrate in environmental media. The primary focus, consistent with the RFCA objectives, is evaluating the potential for contaminants from any medium to impact surface water quality. Evaluation of a contaminant's fate and transport is based upon two criteria: 1) does a complete migration pathway exist based on an evaluation of contaminant transport in each environmental medium; and 2) is there a potential impact to surface water quality based on data collected at representative groundwater and surface water monitoring locations.

A *complete pathway* from surface soil or sediment to surface water is measured at representative surface water monitoring locations; a complete pathway from subsurface soil or groundwater to surface water is measured at representative groundwater monitoring locations (at *Area of Concern wells* and *Sentinel wells*). Figure 2 shows representative groundwater and surface water monitoring locations.

Complete pathways from surface soil/surface sediment to surface water were identified for two surface soil AOIs: americium-241 and plutonium-239/240 (see Section 8.3.3.1 and Tables 8.4 and 8.5 of the RI/FS Report).

Complete pathways from subsurface soil to surface water (via groundwater) were identified for five

subsurface soil AOIs, all of which are volatile organic compounds. These AOIs were carbon tetrachloride, chloroform, methylene chloride, tetrachloroethene, and trichloroethene (see Section 8.4.2.2 and Table 8.6 of the RI/FS Report). All of these subsurface soil AOIs are associated with one or more groundwater areas, listed below.

Complete pathways from shallow (upper hydrostratigraphic unit) groundwater to surface water were identified for 10 groundwater AOIs: uranium (sum of isotopes uranium-233/234, uranium-235, and uranium-238), cis-1,2-dichloroethene, carbon tetrachloride, tetrachloroethene, trichloroethene, chloroform, methylene chloride, nitrate/nitrite (as N), fluoride, and sulfate (see Section 8.4.5 and Table 8.11 of the RI/FS Report). These groundwater AOIs are primarily associated with one or more Sentinel wells in five groundwater areas, specifically:

- North of former Building 771;
- Historical East Trenches area (downgradient portion of plume);
- Historical Solar Evaporation Ponds area and 700 Area Northeast area (downgradient portion of plume);
- Historical Mound Site/Oil Burn Pit No. 2 area (downgradient portion of plumes); and
- Historical 903 Pad/Ryan's Pit area.

Surface water AOIs are not subject to the same fate and transport evaluation because the evaluation focused on potential impacts on surface water quality. The surface water data are provided for reference because they confirm the AOI's presence in surface water (necessary to confirm a complete pathway to surface water exists). Four surface water AOIs were observed intermittently above the highest of the surface water standard, background, or practical quantitation limit at representative surface water locations (see Table 8.4 of the RI/FS Report). These AOIs are plutonium-239/240, americium-241, uranium (sum of isotopes), and nitrate/nitrite (as N).

Air AOIs are not evaluated using this process because air is evaluated based on the potential contaminant exposure received by a human receptor via the airborne pathway, as measured against EPA's 10-millirem (mrem) annual

benchmark level for the airborne pathway (see Section 8.5 of the RI/FS Report). No air AOIs were identified as having a complete pathway.

## Scope and Role of OUs

*Operable Units (OUs)* were originally created at the site based on the type and distribution of contaminants. Over time, the number of OUs was consolidated for purposes of remediation and closure. Before RFCA, the IHSSs were grouped into 15 onsite OUs and 1 offsite OU. The 1996 RFCA consolidated the site into 10 OUs.

In 2004, the RFCA Parties modified the 1996 OU Consolidation Plan in RFCA Attachment 1 to reduce the number of OUs. After additional remedial actions were completed on five of the OUs, the two remaining OUs evaluated in the RI/FS were the Industrial Area (IA) and the Buffer Zone (BZ) OUs. Section 1.0 of the RI/FS Report provides detailed information on the history of the OUs and the IHSSs.

### RECONFIGURATION OF OUS

The RI/FS Report identifies the area of Rocky Flats impacted by DOE activities. Based on the analysis in the report, the RFCA Parties have decided to reconfigure the OU boundaries to consolidate all areas of the site that may require additional remedial actions into a final reconfigured OU. The boundary of this new Central OU also considers practicalities of future land management. The remaining portions of the site have been consolidated into the reconfigured Peripheral OU (please refer to Figure 3).

As stated in the 1996 RFCA paragraph 83:

*Following implementation of all planned accelerated actions, CDPHE and EPA shall evaluate the Site conditions and render final remedial/corrective action decisions for each OU. Notwithstanding the emphasis on accelerated actions and IHSS-based approach, the Parties recognize that the final remedial/corrective action decisions may require some additional work as specified in the CAD/ROD to ensure an adequate remedy.*

The RI/FS Report reevaluated all historical onsite OUs. The RI characterization information and CRA results provide the basis for evaluating remedial alternatives and rendering a final decision for the Peripheral and Central OUs.

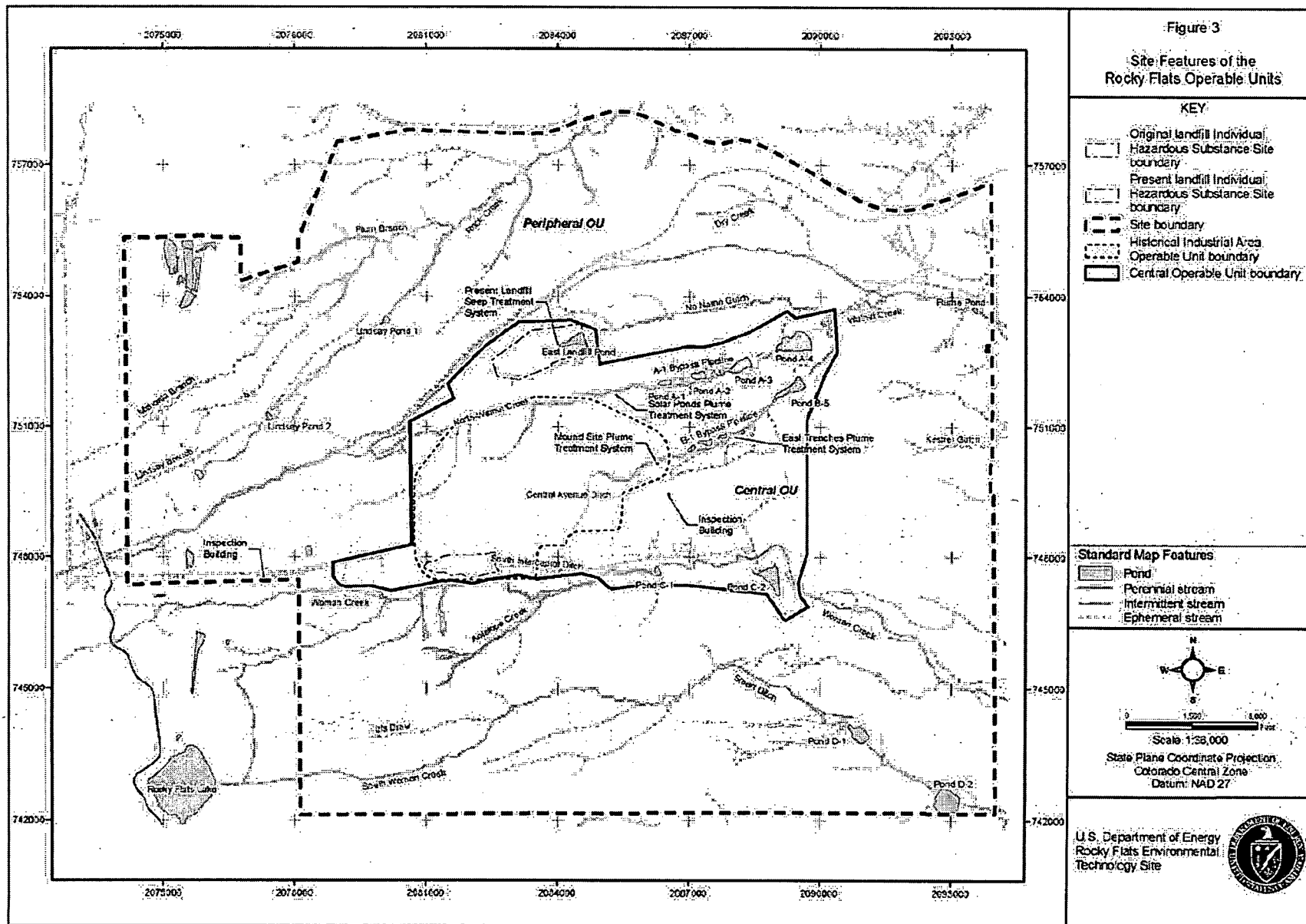


Figure 4 shows the remaining surface features and groundwater treatment systems in the Central and Peripheral OUs. These features are important to understanding why the remedial objectives and proposed remedy are appropriate for the site.

The Peripheral OU has been determined to be unimpacted by site activities from a hazardous waste perspective; that is, no hazardous wastes or constituents have been placed in or migrated to the Peripheral OU. This determination is based on process knowledge including past waste management practices, research into evidence of disturbed areas, and results of extensive sampling.

A small portion of the Peripheral OU was impacted by site activities from a radiological perspective. For example, plutonium-239/240 exists above background in surface soil in the eastern portion of the site.

As illustrated on Figure 4, there are a few sampling locations within the Peripheral OU that exceed a level of 9.8 *picocuries* per gram (pCi/g),<sup>4</sup> which corresponds to a  $1 \times 10^{-6}$  risk level for a WRW. The highest result at these locations is approximately 20 pCi/g. If the highest concentration of 20 pCi/g was considered to be the average concentration over an EU, it would correspond to a risk of approximately  $1 \times 10^{-5}$  for a rural resident, which would be in the middle of the CERCLA acceptable risk range ( $10^{-6}$  to  $10^{-4}$ ).

These levels of *radioactivity* are also far below the 231 pCi/g activity level for an adult rural resident<sup>5</sup> that equates to the 25 mrem/year dose criterion specified in the Colorado Standards for Protection Against Radiation. Based on these results, the Peripheral OU is determined to be acceptable for all uses from a radiological perspective.

<sup>4</sup> The value 9.8 pCi/g is the plutonium-239/240 WRW PRG and is based on a target risk of  $1 \times 10^{-6}$ . See the Final CRA Work Plan and Methodology, Rocky Flats Environmental Technology Site, Golden, Colorado, Revision 1, September 2005.

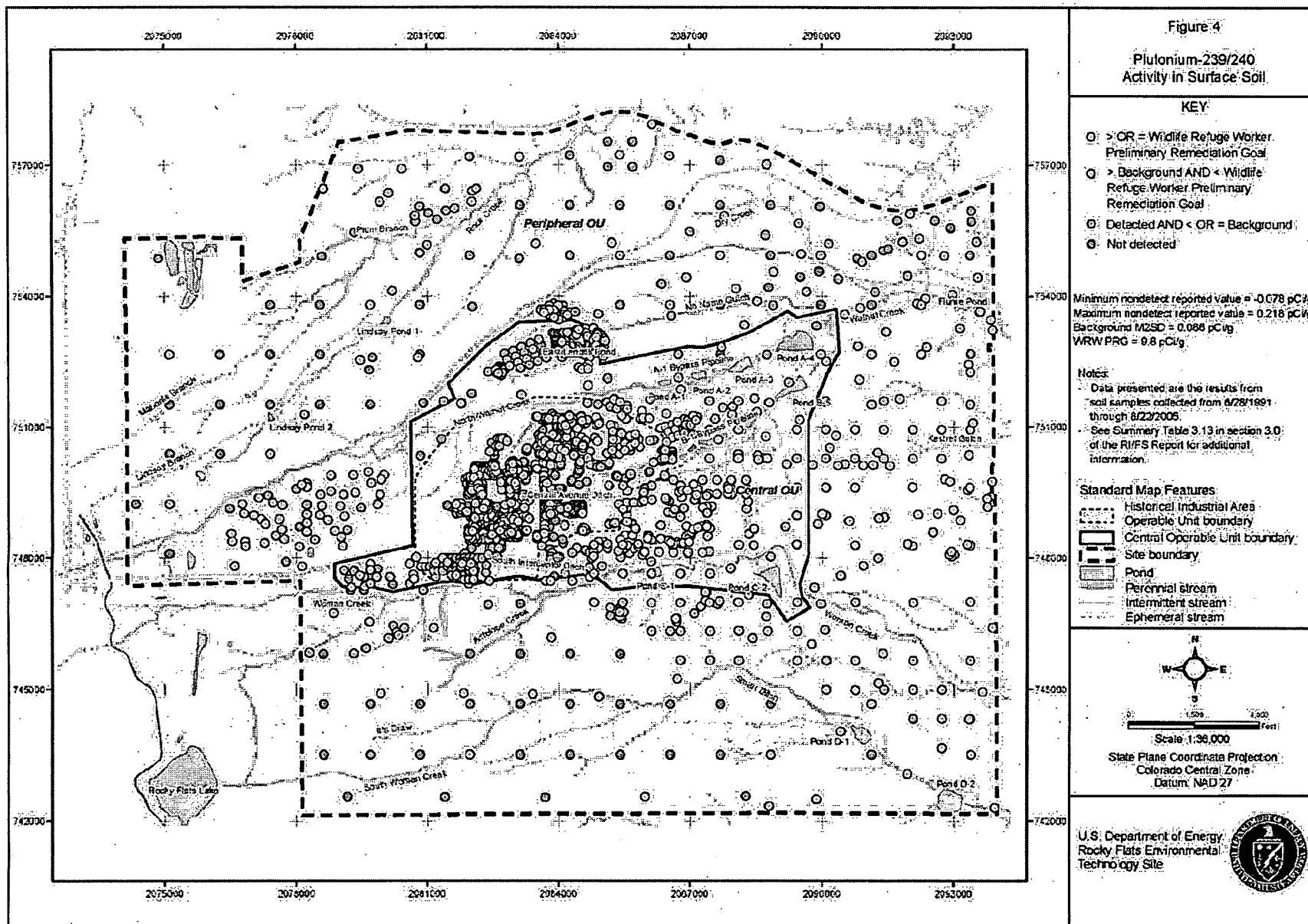
<sup>5</sup> See the plutonium in surface soil target risk level in Table 1-1 of the RSALs Task 3 Report (EPA et al., Task 3 Report and Appendices: Calculations of Surface Radionuclide Soil Action Levels for Plutonium, Americium, and Uranium, Rocky Flats Environmental Technology Site, Golden, Colorado, September 2002).

## Key Conclusions of the Remedial Investigation

Together, the nature and extent of contamination evaluations, results of the Comprehensive Risk Assessment, and contaminant fate and transport information are used to assess the extent to which residual contamination may pose a threat to human health and the environment.

A summary of the Remedial Investigation results is found in Section 9.0 of the RI/FS Report. Key conclusions of the Remedial Investigation include:

- Air emissions present no health or environmental concerns at present and anticipated future levels. Air, therefore, was not evaluated in the Feasibility Study.
- Because the Remedial Investigation concluded that the Peripheral OU poses no current or potential future threat to human health or the environment, a Feasibility Study for this OU was not required and no remedial alternatives were evaluated. DOE is proposing that no remedial action be taken in the Peripheral OU.
- Based on results of the Remedial Investigation, a Feasibility Study was required for the Central OU. The specific media evaluated in the Feasibility Study were:
  - Groundwater
    - Five upper hydrostratigraphic unit groundwater areas where contaminated groundwater may impact surface water;
    - Upper hydrostratigraphic unit groundwater sampling locations where groundwater contamination exceeds *maximum contaminant levels*; and
    - Groundwater sampling locations where exceedances of volatilization PRGs in groundwater indicate a potential indoor air risk.
  - Surface Water
    - Surface water upstream of the terminal ponds, where there are locations where some surface water monitoring results do not meet Colorado surface water quality standards for some analytes.



- Soil

- Subsurface soil where complete pathways from subsurface soil to surface water (via groundwater) may impact surface water;
- Surface soil that may contribute to intermittent exceedances of the surface water standard for americium-241 and plutonium-239/240 upstream of the terminal ponds;
- Surface soil in the Wind Blown Area Exposure Unit where results of the Comprehensive Risk Assessment indicate potential risk to a wildlife refuge worker is  $2 \times 10^{-6}$  for plutonium-239/240; and
- Subsurface soil sampling locations where exceedances of volatilization PRGs in subsurface soil indicate a potential indoor air risk.

Based on data and modeling results, it is likely that residual volatile organic compound sources and associated downgradient groundwater concentrations will persist in the environment for decades to hundreds of years even with the source removals that were implemented as accelerated actions.

Groundwater contamination above maximum contaminant levels exists in some sampling locations at Rocky Flats. Groundwater actions were implemented to treat contaminated groundwater that may impact surface water quality. The actions are:

- The Present Landfill seep treatment system; and
- Three groundwater treatment systems (East Trenches Plume Treatment System, Mound System Plume Treatment System, and Solar Ponds Plume Treatment System), which are operating as designed.

Continued operation of these four systems serves to protect surface water quality over short- and intermediate-term periods by removing contaminant loading to surface water. This protection also serves to meet long-term goals for returning groundwater to its beneficial use of surface water protection.

Surface water sample results do not always meet Colorado surface water quality standards for some

analytes at some onsite monitoring locations upstream of the terminal ponds. Specific mechanisms to prevent use of surface water in these areas are evaluated in the Feasibility Study. Surface water leaving Rocky Flats is acceptable for all uses.

## Summary of Remedial Action Objectives

Remedial action objectives are contaminant-specific goals for the final comprehensive response action and are used in developing and evaluating remedial alternatives. The results of the RI are compared to the RAOs to determine whether additional response actions are needed to meet the RAOs. Final remediation objectives will be incorporated into the CAD/ROD for the selected remedy.

RAOs provide the foundation upon which remedial cleanup alternatives are developed. Based on the results of the RI, RAOs were developed for groundwater, surface water, soil, and environmental protection.

### Groundwater Remedial Action Objective 1

*Meet groundwater quality standards, which are the Colorado Water Quality Control Commission surface water standards, at groundwater Area of Concern (AOC) wells.*

Status: Groundwater RAO 1 is met. For the groundwater AOIs, most current data for those analytes measured in groundwater show concentrations below the highest of the surface water standard, background, or practical quantitation level (PQL) at all AOC wells with one exception (well 10594, which is located downgradient of Pond A-1 in North Walnut Creek, for sulfate results from samples collected in 1995 and 1996).

### Groundwater Remedial Action Objective 2

*Restore contaminated groundwater that discharges directly to surface water as baseflow, and that is a significant source of surface water, to its beneficial use of surface water protection wherever practicable in a reasonable timeframe. This is measured at groundwater Sentinel wells. Prevent significant risk of adverse ecological effects.*

Status: The first part of Groundwater RAO 2 (restore contaminated groundwater to its beneficial use) is not met at all Sentinel wells; however, at this time, no other additional actions can reasonably be

taken. The second part of Groundwater RAO 2 (prevent significant risk of adverse ecological effects) is met.

### **Groundwater Remedial Action Objective 3**

*Prevent domestic and irrigation use of groundwater contaminated at levels above MCLs.*

Status: This RAO is not met. There are some sampling locations within the Central OU where groundwater contamination exceeds MCLs. Specific mechanisms to prevent use of groundwater in these areas are evaluated in the FS.

### **Surface Water Remedial Action Objective**

*Meet surface water quality standards, which are the Colorado Water Quality Control Commission surface water standards.*

Status: This RAO is met at all surface water Points of Compliance (POCs) (see Figure 2) because no surface water AOIs exceed the surface water standards at any surface water POCs (or, for those surface water AOIs where data are not available at the surface water POCs, at the surface water monitoring location immediately upstream of the surface water Points of Compliance). However, surface water sample results do not always meet Colorado surface water quality standards for some analytes at some onsite monitoring locations upstream of the terminal ponds. Specific mechanisms to prevent use of surface water in these areas are evaluated in the FS.

### **Soil Remedial Action Objective 1**

*Prevent migration of contaminants to groundwater that would result in exceedances of groundwater RAOs.*

Status: This RAO is not met everywhere in the Central OU. Soil sources of groundwater contamination have been removed by accelerated actions; however, some subsurface soil AOIs with complete pathways from subsurface soil to surface water (via groundwater) may be above the surface water standard at one or more Sentinel wells (refer to Figure 2). At this time, no other additional actions can reasonably be taken.

### **Soil Remedial Action Objective 2**

*Prevent migration of contaminants that would result in exceedances of surface water RAOs.*

Status: This RAO is met provided residual soil contamination is not disturbed. If residual soil contamination is disturbed, the contamination could migrate to surface water via erosion which could result in some surface water sample results above surface water standards at some surface water monitoring locations. Specific mechanisms to prevent disturbance of soil are evaluated in the FS.

### **Soil Remedial Action Objective 3**

*Prevent exposures that result in unacceptable risk to the WRW. The  $10^{-6}$  risk level shall be used as the point of departure for determining remediation goals for alternatives when ARARs are not available or are not sufficiently protective because of the presence of multiple contaminants at the site or multiple pathways of exposure (40 Code of Federal Regulations [CFR] 300.430[e][2][i][A][2]). Prevent significant risk of adverse ecological effects.*

Status: As described in the following paragraphs, Soil RAO 3 is not met for human health, but it is met for the environment.

The CRA does not evaluate an unrestricted scenario, but instead evaluates potential risk to the anticipated future user (WRW and WRV), based on a number of exposure assumptions. Specific mechanisms to ensure that the assumptions are met are evaluated in the FS.

The assessment of the indoor air volatilization pathway concludes that the indoor air inhalation pathway is potentially significant if buildings were constructed and occupied over some sampling locations onsite where there are exceedances of volatilization PRGs in subsurface soil and groundwater.

The calculated risks for all surface soil/surface sediment COCs fell near the low end of EPA's acceptable risk range. All COCs, except plutonium-239/240 in the WBEU, were either comparable to background risks or were of limited spatial extent or location. Results of the CRA indicate potential risk to a WRW is  $2 \times 10^{-6}$  for exposure to plutonium-239/240 in surface soil in the WBEU. While this level of residual contamination is protective of human health, the FS evaluates removal of surface soil within the EU to reduce the residual plutonium-239/240 contamination to below 9.8 pCi/g, which is the  $1 \times 10^{-6}$  WRW PRG.

The overall conclusions from the ERA indicate that site conditions due to residual contamination do not represent significant risk of adverse ecological effects to receptors from exposure to site-related residual contamination. This RAO is met for the environment.

## Summary of Remedial Alternatives

Regardless of which alternative is selected for the Central OU, DOE will construct a barbed wire fence around the Central OU for land management purposes. The fence will not be part of the remedy.

Section 121 (c) of CERCLA requires that remedial actions at a site resulting in hazardous substances, pollutants, or contaminants remaining above levels that allow for unlimited use and unrestricted exposure be reviewed not less than every 5 years to assure protection of human health and the environment. This requirement applies to all of the alternatives for the Central OU.

### PREFERRED ALTERNATIVE AND PROPOSED REMEDY

The remedial alternatives considered for the Central OU were:

- Alternative 1: No Further Action With Monitoring
- Alternative 2: Institutional and Physical Controls
- Alternative 3: Targeted Surface Soil Removal

The preferred alternative for the Central OU is Alternative 2: Institutional and Physical Controls.

Because the Peripheral OU poses no current or potential future threat to human health or the environment, remedial alternatives were not evaluated. No action is recommended for the Peripheral OU.

## Evaluation of Alternatives

No remedial action alternatives were evaluated for the Peripheral OU.

A detailed analysis of alternatives, conducted as part of the RI/FS Report, evaluated each of the remedial action alternatives for the Central OU using the nine CERCLA criteria listed below. Table 2 provides a detailed analysis of the alternatives.

### SUMMARY OF ALTERNATIVES

#### Alternative 1: No Further Action With Monitoring

This alternative maintains and monitors the completed actions at the Present and Original Landfills and the three groundwater plume treatment systems. Specific monitoring and operating and maintenance requirements for these five actions will continue.

#### Alternative 2: Institutional and Physical Controls

This alternative adds the implementation of institutional and physical controls to Alternative 1. *Institutional controls* include legally enforceable and administrative land use restrictions and physical controls, including signage or other physical features, to control access and activity within the Central OU. Land use restrictions are limitations or prohibitions on specific activities within designated areas of the Central OU to ensure that the conditions remain protective for the WRW and WRV. Physical controls are items such as signage. DOE will retain jurisdiction over the engineered structures and monitoring systems associated with the completed actions. Institutional controls for the Central OU will include the following:

1. The construction and use of buildings that will be occupied on a permanent or temporary basis (such as for residences or offices) is prohibited.
2. Excavation, drilling, and other intrusive activities below a depth of 3 feet are prohibited, except for remedy-related purposes.
3. No grading, excavation, digging, tilling, or other disturbance of any kind of surface soils is permitted, except in accordance with an erosion control plan approved by CDPHE or EPA. Any such soil disturbance shall restore the soil surface to pre-existing grade.
4. Surface water above the terminal ponds may not be used for drinking water or agricultural purposes.
5. The construction or operation of groundwater wells is prohibited, except for remedy-related purposes.
6. Digging, drilling, tilling, grading, excavation, construction of any sort (including construction of any structures, paths, trails, or roads), and vehicular traffic are prohibited on the covers of the Present Landfill and the Original Landfill, except for authorized response actions.
7. Activities that may damage or impair the proper functioning of any engineered component of the response action, including but not limited to any treatment system, monitoring well, landfill cap, or surveyed benchmark are prohibited.

Institutional controls will be embodied in a post-RFCA enforceable document and an *environmental covenant*.

Physical controls will consist of signage installed along the perimeter of the Central OU to notify the WRW and WRV that they are at the boundary of the Central OU.

Institutional and physical controls will be inspected every 3 months. If evidence of activities that violate the restrictions or damage of the physical controls is found, a plan will be developed to correct the condition and the correction will be implemented. Inspections and corrective actions will be documented in an annual report to the regulatory agencies.

#### Alternative 3: Targeted Surface Soil Removal

This alternative includes implementation of the institutional and physical controls of Alternative 2. In addition, this alternative would remove the top 6 inches of soil in areas of residual surface soil contamination that have activities above the plutonium-239/240 WRW PRG (based on  $1 \times 10^{-6}$  target risk) concentration of 9.8 pCi/g, an area of approximately 368 acres. Note that this alternative may not completely remove all plutonium contamination within the 368 acres; however, the residual risk based on the EU is expected to be well below  $1 \times 10^{-6}$  if Alternative 3 is implemented. Previous excavation actions of a similar nature resulted in successful removal of contamination, as verified through post-acceleration action confirmation sampling based on a 90-percent confidence level. The removed soil would be placed in shipping containers and then shipped for disposal at a permitted low-level waste disposal facility.

**TABLE 2**  
**Analysis of Alternatives for the Central Operable Unit**

	<b>No Further Action With Monitoring (Alternative 1)</b>	<b>Institutional and Physical Controls (Alternative 2)</b>	<b>Targeted Surface Soil Removal (Alternative 3)</b>
<b>Alternative Description</b>	Maintains and monitors the completed actions conducted at the Present and Original Landfills and the three groundwater treatment systems. Specific monitoring and O&M requirements for these five actions will continue. Alternative 1 also includes additional surface water, sediment, and ecological monitoring based on results of the ERA and surface and groundwater monitoring as described in the FY2005 IMP, dated September 8, 2005.	Includes Alternative 1 plus institutional and physical controls. Institutional controls include legally enforceable and administrative land use restrictions. Physical controls include signs.	Includes Alternative 2 plus targeted removal of surface soil within an EU to reduce the residual plutonium-239/240 contamination to below 9.8 pCi/g, which is the $1 \times 10^{-6}$ WRW target risk concentration.
<b>Evaluation Criteria</b>			
<b>Overall Protection of Human Health and the Environment</b>	<p>This alternative is protective of human health and the environment in the current site land configuration because no unacceptable risks from residual contamination exist after completion of all planned accelerated actions.</p> <ul style="list-style-type: none"> <li>The CRA shows that the incremental risk to the WRW falls within the acceptable range of <math>1 \times 10^{-6}</math> to <math>1 \times 10^{-4}</math> cancer risks and below an HI of 1 for noncarcinogenic effects.</li> <li>The CRA predicts that there is no significant ecological risk from residual contamination within all environmental media across RFETS.</li> <li>Actions at the Present and Original Landfills provide protection of human health and the environment.</li> <li>Groundwater actions are operating as designed to remove contamination captured to meet appropriate surface water quality standards at surface water POCs.</li> <li>Monitoring of groundwater, surface water, sediment, and ecology provides data to verify that RFETS continues to be protective of human health and the environment. The IMP also includes environmental monitoring of the Present and Original Landfills, the Present Landfill seep treatment system, and the three groundwater treatment systems.</li> </ul> <p>This alternative may not be protective of human health if the current site land configuration were to change. In particular:</p> <ul style="list-style-type: none"> <li>Because the CRA does not evaluate an unrestricted scenario, but instead evaluates potential risk to the anticipated future user, the assumptions used in the CRA human health calculations, including the assumptions used in calculating the WRW PRGs, need to be embodied in an institutional control.</li> <li>Residual soil contamination exists in the Central OU. If residual soil contamination is disturbed, the contamination could migrate to surface water via erosion which could result in some surface water sample results above surface water standards at some surface water monitoring locations.</li> <li>Subsurface soil and groundwater contamination exists above the indoor air volatilization PRGs.</li> <li>Groundwater contamination exists in the Central OU above MCLs.</li> </ul>	<p>This alternative is protective of human health and the environment because:</p> <ul style="list-style-type: none"> <li>See Alternative 1.</li> <li>Alternative 2 increases the protectiveness of Alternative 1 because institutional controls will provide the following: <ul style="list-style-type: none"> <li>The construction and use of buildings that will be occupied on a permanent or temporary basis (such as for residences or offices) is prohibited. The construction and use of storage sheds or other nonoccupied structures is permitted, consistent with the restrictions below, and provided such use does not impair any aspect of the response action at Rocky Flats.</li> <li>Excavation, drilling, and other intrusive activities below a depth of 3 ft are prohibited, except for remedy-related purposes.</li> <li>No grading, excavation, digging, tilling, or other disturbance of any kind of surface soils is permitted, except in accordance with an erosion control plan approved by CDPHE or EPA. Any such soil disturbance shall restore the soil surface to pre-existing grade.</li> <li>Surface water above the terminal ponds may not be used for drinking water or agricultural purposes.</li> <li>The construction or operation of groundwater wells is prohibited, except for remedy-related purposes.</li> <li>Digging, drilling, tilling, grading, excavation, construction of any sort</li> </ul> </li> </ul>	<p>This alternative is protective of human health and the environment because:</p> <ul style="list-style-type: none"> <li>See Alternatives 1 and 2.</li> <li>Alternative 3 increases the protectiveness of Alternatives 1 and 2 because targeted surface soil removal will reduce plutonium-239/240 contamination to below 9.8 pCi/g.</li> <li>Surface soil removal will result in short-term adverse impacts to ecological resources, including potential impacts to Preble's meadow jumping mouse habitat.</li> <li>Removal of surface soil increases the potential to mobilize residual contamination, particularly if a large area of soil is removed, or if the removal is on a steep slope or in close proximity to a stream segment. It also increases the potential for wind erosion.</li> </ul>

TABLE 2 (CONTINUED FROM PAGE 21)

	No Further Action With Monitoring (Alternative 1)	Institutional and Physical Controls (Alternative 2)	Targeted Surface Soil Removal (Alternative 3)
	<ul style="list-style-type: none"> <li>Surface water quality standards are met at the surface water POCs. However, surface water sample results do not always meet Colorado surface water standards for some analytes at some onsite surface water monitoring locations upstream of the terminal ponds.</li> <li>Institutional controls for the Original Landfill are not in place.</li> <li>There are no prohibitions on affecting the engineered aspects of the remedy.</li> </ul>	<p>(including construction of any structures, paths, trails, or roads), and vehicular traffic are prohibited on the covers of the Present Landfill and the Original Landfill, except for authorized response actions.</p> <ul style="list-style-type: none"> <li>Activities that may damage or impair the proper functioning of any engineered component of the response action, including but not limited to any treatment system, monitoring well, landfill cap, or surveyed benchmark, are prohibited.</li> <li>Signs will be installed as a physical control along the perimeter of the Central OU.</li> </ul>	
<b>Compliance With ARARs and RAOs</b>	This alternative complies with most ARARs; however, it does not meet all ARARs. This alternative does not meet all RAOs.	This alternative complies with all ARARs and meets all RAOs.	This alternative complies with all ARARs and meets all RAOs.
<b>Long-Term Effectiveness and Permanence</b>	<ul style="list-style-type: none"> <li>Most of the RFCA accelerated actions (except the landfills) included removal of contaminated structures and environmental media providing a high degree of long-term effectiveness and permanence.</li> <li>Landfills have been closed in accordance with regulatory agency-approved closure plans as long-term solutions.</li> <li>Remaining building structures either meet free release standards or have fixed contamination that is 6 ft or more below ground surface.</li> <li>Groundwater treatment systems are permanent passive systems requiring limited operational attention.</li> <li>Monitoring of groundwater and surface water provides additional assurance of permanence.</li> </ul>	<p>See Alternative 1 plus:</p> <ul style="list-style-type: none"> <li>Institutional controls are designed to provide the mechanisms that permanently maintain the completed actions conducted at RFETS and the monitoring consistent with the requirements in all accelerated action decision documents.</li> <li>In the very long term, institutional controls may fail.</li> <li>An environmental covenant will increase the long-term permanence of institutional controls.</li> </ul>	<p>See Alternative 2 plus:</p> <ul style="list-style-type: none"> <li>Removal of surface soil will permanently and effectively reduce plutonium-239/240 contamination to below 9.8 pCi/g.</li> <li>Surface soil removal reduces remaining residual surface contamination that could be mobilized in the future if disturbed.</li> </ul>
<b>Reduction of Toxicity, Mobility, or Volume Through Treatment</b>	<ul style="list-style-type: none"> <li>Groundwater treatment systems provide for a reduction of VOCs or uranium and nitrate reducing the overall volume of contaminants in the groundwater and protecting the adjacent surface water.</li> <li>The Present Landfill seep treatment system provides treatment to remove the VOC contamination from the landfill seep.</li> </ul>	See Alternative 1.	See Alternative 1.
<b>Short-Term Effectiveness</b>	Workers and the public are not at risk because no additional action is required in this alternative.	<p>See Alternative 1 plus:</p> <ul style="list-style-type: none"> <li>Institutional controls are effective immediately after the controls have been established.</li> </ul>	<p>See Alternative 2 plus:</p> <ul style="list-style-type: none"> <li>Removal of surface soil will result in an incremental risk to the workers and the public through the removal and transportation operations.</li> <li>Surface soil removal will result in short-term adverse impacts to ecological resources.</li> </ul>

TABLE 2 (CONTINUED FROM PAGE 22)

	No Further Action With Monitoring (Alternative 1)	Institutional and Physical Controls (Alternative 2)	Targeted Surface Soil Removal (Alternative 3)
			<ul style="list-style-type: none"> <li>Removal of surface soil increases the potential to mobilize residual contamination, particularly if a large area of soil is removed, or if the removal is on a steep slope or in close proximity to a stream segment. It also increases the potential for wind erosion.</li> </ul>
<b>Implement-ability</b>	<ul style="list-style-type: none"> <li>No further action is easily implemented because all accelerated actions are complete.</li> <li>Post-accelerated action monitoring of the Present and Original Landfills is easily implemented because the monitoring systems are established.</li> <li>Monitoring through the IMP is easily implemented because the monitoring network is established.</li> </ul>	<p>See Alternative 1 plus:</p> <ul style="list-style-type: none"> <li>Institutional controls and an environmental covenant are easily implemented.</li> <li>Physical controls, such as signage, are easily implemented.</li> </ul>	<p>See Alternative 2 plus:</p> <ul style="list-style-type: none"> <li>Even though standard earthmoving and transportation equipment is readily available, implementing the alternative without impacting surface water quality is difficult.</li> <li>Weather, wind, and precipitation will increase the potential for soil erosion and sediment loads to the RFETS drainages.</li> <li>Major construction to support the long duration of the work would be required.</li> </ul>
<b>Cost<sup>a</sup></b>	<p>Capital Cost: \$0 Annual O&amp;M Cost: \$2,530,000 Present Worth Cost: \$41,350,000</p> <p>Groundwater treatment system media replacement costs are estimated at \$728,000 every 5 years. The estimated cost for preparing materials for the CERCLA periodic reviews is \$153,000 every 5 years.</p>	<p>Capital Cost: \$1,120,000 Annual O&amp;M Cost: \$45,000 (Alternative 2 only)</p> <p>Total Annual O&amp;M Cost: \$2,575,000 (includes Alternatives 1 and 2), less the periodic media replacement costs and CERCLA review costs Present Worth Cost: \$43,170,000 (includes Alternatives 1 and 2)</p>	<p>Capital Cost: \$222,340,000 (assumes up to approximately 368 acres for surface soil removal and disposal as low-level radionuclide-contaminated soil)</p> <p>Total Capital Cost: \$223,460,000 (includes Alternatives 1, 2, and 3)</p> <p>Annual O&amp;M Cost: Varies from \$206,000 to \$70,000 (Alternative 3 only)</p> <p>Total Annual O&amp;M Cost: \$2,781,000 to \$2,645,000 (includes Alternatives 1, 2, and 3), less the periodic media replacement costs and CERCLA review costs</p> <p>Present Worth Cost: \$265,510,000 (includes Alternatives 1, 2, and 3)</p>
<b>State Acceptance</b>	Discussion of this criterion will be provided in the CAD/ROD.	Discussion of this criterion will be provided in the CAD/ROD.	Discussion of this criterion will be provided in the CAD/ROD.
<b>Community Acceptance</b>	Discussion of this criterion will be provided in the CAD/ROD.	Discussion of this criterion will be provided in the CAD/ROD.	Discussion of this criterion will be provided in the CAD/ROD.

<sup>a</sup> Capital costs are in 2005 dollars and O&M costs are calculated for 30 years at a discount rate of 5 percent.

## Criteria Used to Compare Remedial Action Alternatives at CERCLA Sites

### Threshold Criteria

To be retained for further consideration, alternatives must meet the first two criteria, called threshold criteria.

1. **Overall Protection of Human Health and the Environment** considers whether an alternative provides adequate protection by eliminating, reducing, or controlling unacceptable risks.
2. **Compliance With ARARs** considers whether an alternative will meet all federal and state standards required by environmental laws or, if not, whether there is justification for waiving the standards.

### Primary Balancing Criteria

Alternatives that meet the threshold criteria are evaluated against the primary balancing criteria.

3. **Long-Term Effectiveness and Permanence** considers the magnitude of the public health risk that will remain after each alternative is implemented.
4. **Reduction of Toxicity, Mobility, and Volume Through Treatment** indicates EPA's preference for alternatives that include physical or chemical treatment processes to reduce or eliminate the hazardous nature of material, its ability to move in the environment, and the quantity left after treatment.
5. **Short-Term Effectiveness** considers the risks that might be posed to the community and workers during the implementation of each alternative and the time it will take each alternative to achieve protection of human health and the environment.
6. **Implementability** considers the technical and administrative feasibility of implementing each alternative and the availability of the services and materials required during implementation.
7. **Cost** considers construction costs and operation and maintenance (O&M) cost of each alternative. Alternative costs are compared by considering whether more costly alternatives provide additional public health benefits for the increased cost.

## Modifying Criteria

The last two criteria are used to evaluate concerns the state and public may have regarding each alternative. **State and community acceptance will be evaluated based on comments received on this Proposed Plan during the public comment period.**

8. **State Acceptance** considers whether the state agrees with, disagrees with, or has no comment on the analysis of alternatives and selection of the Preferred Alternative.
9. **Community Acceptance** considers the concerns or support the public may have regarding each alternative.

## Comparison of Alternatives

### Overall Protection of Human Health and the Environment

The analysis of this threshold criterion considers whether or not an alternative provides adequate protection by eliminating, reducing, or controlling unacceptable risks.

Alternative 1 is protective of human health and the environment in the current site land configuration because no unacceptable risks from residual contamination exist after the completion of all planned RFCA accelerated actions. However, Alternative 1 is not as protective of human health and the environment as Alternatives 2 and 3 for the following reasons:

1. The CRA does not evaluate an unrestricted scenario, but instead evaluates potential risk to the anticipated future user (WRW and WRV), based on a number of exposure assumptions. Alternative 1 does not ensure that these exposure assumptions continue to be met.
2. Residual soil contamination exists in the Central OU. If residual soil contamination is disturbed, the contamination could migrate to surface water via erosion which could result in some surface water sample results above surface water standards at some surface water monitoring locations. Alternative 1 would not prevent the disturbance of soil.
3. Contaminated subsurface features remain in the subsurface in the former IA. These features were not evaluated in the CRA because the assessment was based on the assumption that there is no exposure pathway for a WRW because he or she will not be digging below

8 feet. Alternative 1 would not prevent these activities.

4. Subsurface soil and groundwater contamination exists above the indoor air volatilization PRGs. Alternative 1 does not actively prevent the possibility of an unacceptable risk of exposure to the WRW if a building were constructed over the area contaminated above the indoor air volatilization PRGs and the building was routinely occupied.
5. Groundwater contamination exists in the Central OU above MCLs. Alternative 1 does not actively prevent the use of this groundwater for domestic or irrigation purposes.
6. Surface water quality standards are met at the surface water POCs; however, surface water sample results do not always meet Colorado surface water standards for some analytes at some onsite surface water monitoring locations upstream of the terminal ponds. Alternative 1 does not actively prevent the use of this surface water.
7. The Present Landfill RFCA Decision Document requires institutional controls to be put in place at the time the post-closure period begins. However, institutional controls for the Original Landfill are not in place.
8. There are no prohibitions on activities affecting the engineered aspects of the remedy.

Alternatives 2 and 3 provide overall protection of human health and the environment. Although Alternative 3 further reduces risk to a WRW by removing areas of residual plutonium-239/240 surface soil contamination, the short-term impact to the environment and cost of additional surface soil removal above the target risk-based concentration of 9.8 pCi/g is high.

**Compliance With ARARs** – The analysis of this threshold criterion determines how the alternative meets the federal and state ARARs that have been identified for use in the evaluation of the alternatives and the selection.

Alternatives 2 and 3 meet the ARARs for Rocky Flats through institutional controls.

**Long-Term Effectiveness and Permanence** – This analysis considers the magnitude of residual contamination and/or risk after the alternative has been implemented and the adequacy, suitability, and reliability of the alternative to control/manage the residual contamination and risk.

With the completion of all accelerated actions, Alternative 1 achieves a moderate degree of long-term effectiveness and permanence. The accelerated action closures of the Present Landfill and Original Landfill, and the operation of three groundwater treatment systems, are designed for long-term physical integrity and use. Monitoring and maintenance plans are implemented to sustain the effectiveness and permanence of these actions. However, long-term effectiveness and permanence for Alternative 1 is compromised by the absence of institutional controls. Alternative 2 increases the effectiveness and permanence of the actions by reducing exposures resulting in acceptable risk to the WRW through institutional controls that prohibit the construction and use of buildings and by placing restrictions on excavation or activities that cause soil disturbance. Institutional controls will prevent use of surface water and groundwater and/or pumping groundwater where the remedy may be impacted in the Central OU. Alternative 3 removes surface soil with residual contamination of plutonium-239/240 above the target risk-based concentration of 9.8 pCi/g and provides, through removal, a permanent and effective action.

Alternative 3 provides the most permanent long-term action. Alternative 2 ranks close to Alternative 3 in long-term effectiveness.

**Reduction of Toxicity, Mobility, and Volume Through Treatment** – This analysis considers the treatment of residual contamination to reduce the contaminant toxicity, mobility, and volume. The analysis will describe the treatment process, degree of treatment, degree to which the treatment is irreversible, and volume reduction achieved through treatment.

All of the alternatives are equivalent because the only treatment considered in any of the alternatives occurs in the groundwater and Present Landfill seep treatment systems, which remain the same through all of the alternatives.

**Short-Term Effectiveness** – This analysis addresses the protection of the community and workers while

implementing the alternative, the environmental impacts while implementing the alternative, and the time required to achieve the RAOs.

Alternatives 1 and 2 provide a high degree of short-term effectiveness because the alternatives will not pose a risk to the workers or the public during implementation. The removal of large areas of surface soil with residual contamination as described in Alternative 3 will entail increased risks to workers from earthmoving and waste transportation activities. Risks to the public are expected to be low, although higher than from Alternatives 1 and 2. This risk is due to the large volume of soil and waste materials to be excavated and transported offsite for disposal. Additionally, there will be a short-term impact to affected ecological resources that increases with the amount of sediment loading to surface water.

Alternatives 1 and 2 provide the most short-term effectiveness.

**Implementability** – This analysis considers the ability to build and operate the alternative, the reliability of the alternative, the ability to monitor the effectiveness of the alternative, the administrative feasibility of the alternative, and the availability of resources to implement the alternative.

Alternative 1 is easily implemented because no further actions need to be conducted. In addition, the IMP and landfills and groundwater treatment monitoring systems are already in place.

Alternative 2 is easily implemented by establishing institutional controls and installing the physical controls (signage). These activities are not expected to entail direct exposure to residual contamination.

Alternative 3 is moderately difficult to implement. Even though standard earthmoving and transportation equipment is readily available, implementing the alternative without impacting surface water quality is difficult. The implementation of the surface soil removal is difficult due to the large extent and large volume of soil to be managed. Wind and precipitation will also increase the potential for soil erosion and sediment loads to the Rocky Flats drainages during the removal process. Major construction to support the long duration of the work (for example, new

temporary roadways) would be required to implement Alternative 3.

Alternatives 1 and 2 are the most implementable alternatives.

**Cost** – This criterion presents order-of-magnitude capital and O&M costs of the alternative. The O&M cost estimates will include the anticipated O&M costs along with administrative costs, replacement costs, and the cost of periodic reviews. A present worth analysis is also included for a period of 30 years with a discount rate of 5 percent. Present worth analysis is a method of evaluation of expenditures that occur over different time periods. By discounting all costs to a common base year, the costs for different remedial action alternatives can be compared on the basis of a single figure for each alternative. When calculating present worth cost for CERCLA sites, total O&M costs are to be included.

The cost of Alternative 1 is only slightly increased by the addition of Alternative 2 (5 percent increase in present worth cost). The removal of surface soil contamination in Alternative 3 adds a large increment of cost (750 percent increase in present worth cost). Alternative 3 provides only a small incremental benefit (reducing potential risk from  $2 \times 10^{-6}$  to below  $1 \times 10^{-6}$ ) and entails high costs and high short-term risks (increased worker risk and mobilization of contaminants).

Alternative 2 is the most cost-effective action.

**State Acceptance** – This analysis evaluates the technical and administrative issues and concerns the state regulatory agency may have on the alternative. Discussion of this criterion will be provided in the CAD/ROD after comments are received on this Proposed Plan.

**Community Acceptance** – This analysis evaluates the technical and administrative issues and concerns that the community may have on the alternative. Public involvement is encouraged through public hearings and submittal of public comments. Public comments received on this Proposed Plan will be reviewed and this criterion will be discussed in the CAD/ROD.

### Summary of Alternative Evaluation

Alternative 1 cannot meet ARARs or RAOs and is a less effective and permanent remedy than

Alternatives 2 and 3. Alternative 1 lacks the institutional controls of Alternatives 2 and 3 and the additional environmental risk reduction offered by Alternative 3. It is not as protective of human health and the environment. Alternative 3 would entail additional risks to workers and the potential to mobilize contaminants. In addition, the implementation of Alternative 3 would be more difficult and the cost would be significantly higher than that of the other alternatives. Alternative 2 complies with ARARs, protects human health and the environment, is an effective and permanent remedy, and does not introduce risks to workers or the mobilization of contaminants.

### Proposed Remedy

*The proposed action for the Peripheral OU is No Action because the Peripheral OU poses no current or potential future threat to human health or the environment and is acceptable for all uses.*

*The preferred alternative for the Central OU is Alternative 2, Institutional and Physical Controls, which is protective of human health and the environment and achieves all of the RAOs.*

The expected result of implementing the preferred alternative is that the anticipated future use of the Central OU area is acceptable. Current site conditions, in combination with institutional controls and adequate monitoring and maintenance, ensure that both human health and the environment will be adequately protected.

The preferred alternative for the Central OU will be implemented as follows:

- The Rocky Flats Environmental Covenant will be modified to include all of the institutional controls required for the Central OU.
- Signs will be installed along the perimeter of the Central OU.

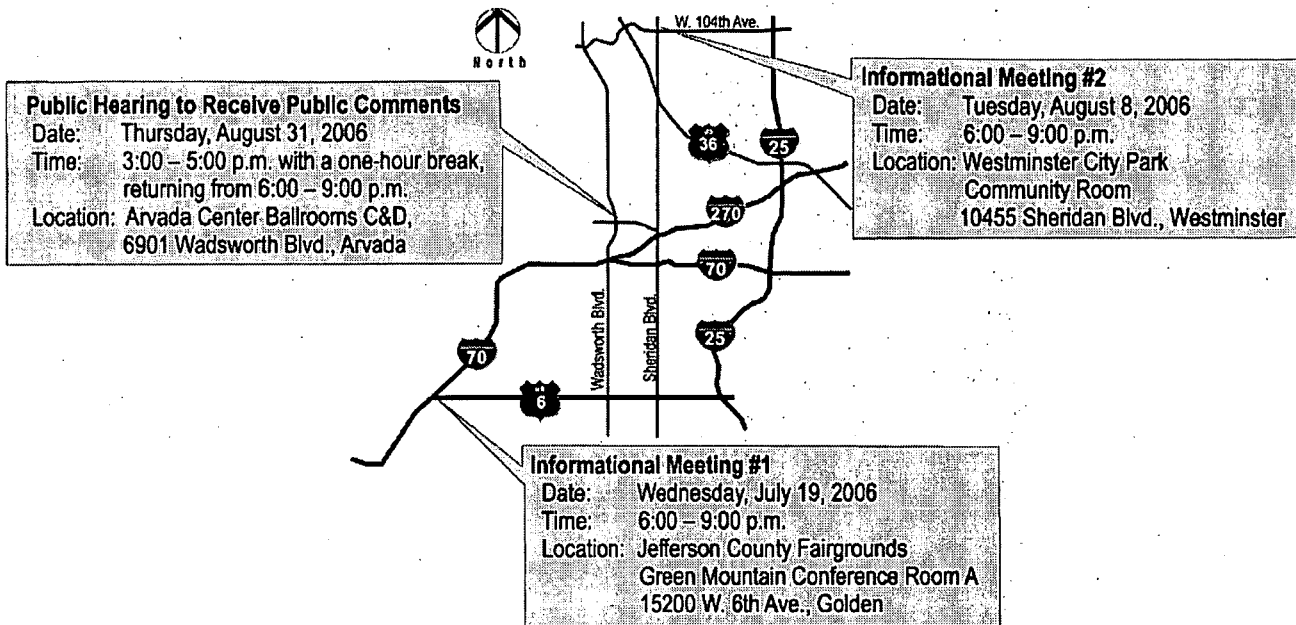
- DOE will retain jurisdiction of real property and facilities to be used in carrying out any final response action.
- O&M and monitoring activities will be conducted pursuant to an interagency agreement/corrective action order which is currently being negotiated by the RFCA Parties.

Based on information currently available, DOE believes the preferred alternative for the Central OU meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. DOE expects the preferred alternative for the Central OU to satisfy the following statutory requirements of CERCLA Section 121(b): 1) Be protective of human health and the environment; 2) Comply with ARARs; 3) Be cost-effective; 4) Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and 5) Satisfy the preference for treatment as a principal element.

It is DOE's judgment that the preferred alternative identified in the Proposed Plan is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

The public is encouraged to review and comment on all of the remedial alternatives considered for the Central OU and the proposed No Action for the Peripheral OU. The preferred alternative for the Central OU and proposed No Action for the Peripheral OU can be changed in the selected remedy in the CAD/ROD, in response to public comment or new information.

## Map to Meeting Locations



### WAYS TO COMMENT ON THE PROPOSED PLAN

The 60-Day Public Comment Period on the Proposed Plan ends on September 13, 2006. Mailed comments must be postmarked no later than September 13, 2006.

Please mail comments to:

Attention: Proposed Plan Comments  
 U.S. Department of Energy  
 Rocky Flats Environmental Technology Site  
 12101 Airport Way Unit A  
 Broomfield, CO 80021-2583

You may also email your comments to: [comments@rf.doe.gov](mailto:comments@rf.doe.gov)

Comments on the Proposed Plan may be submitted orally or in writing at the Public Hearing, to be held on:

Thursday, August 31, 2006, 3:00-5:00 p.m. and 6:00-9:00 p.m.  
 Arvada Center Ballroom (C&D) 6901 Wadsworth Blvd. Arvada.

Comments must be received during the public comment period for consideration by the Agencies.

The final Administrative Record for the CAD/ROD will include the Proposed Plan, the response by the RFCA Parties to comments received, and an explanation of any significant differences between the preferred alternative and proposed action in the Proposed Plan and the final selected remedy.

# Glossary

Americium (Am)	A silver white metallic transuranic element of the actinide series, having isotopes with mass numbers from 237 to 246 and half lives from 25 minutes to 7,950 years. Americium is a chemical element artificially produced by bombarding plutonium with neutrons. Americium-241, which represents most of Rocky Flats' Am, has a half-life of approximately 430 years.
Applicable or Relevant and Appropriate Requirement (ARAR)	Standards or other environmental protection requirements promulgated under federal or state law that address a hazardous substance, pollutant, contaminant, action, location, or other circumstance found at a CERCLA site. Section 121(d) of CERCLA requires that ARARs be met at CERCLA sites.
Aquatic Exposure Unit (AEU)	AEUs are areas over which long-term risks to the chosen aquatic receptors are assessed from exposure to surface water and sediment within aquatic systems at Rocky Flats. AEUs are reasonable aggregations of common surface water and hydrological systems and habitat for assessing ecological risks. Rocky Flats was divided into 7 AEUs for the Comprehensive Risk Assessment.
Area of Concern (AOC) wells	Wells that are within a drainage and downgradient of a contaminant plume or group of contaminant plumes. These wells are monitored to determine whether the plume(s) may be discharging to surface water.
Atomic Energy Act (AEA)	Atomic Energy Act of 1954, 42 U.S.C. §2011 <i>et seq.</i> , as amended, and its implementing regulations.
Buffer Zone	The roughly 5,900 acres at Rocky Flats that were unoccupied by buildings or development, providing a safety and security buffer. It surrounded the Industrial Area and EPA regulates its cleanup.
Colorado Hazardous Waste Act (CHWA)	Colorado statute that regulates the generation, transportation, and disposal of hazardous waste. Sections 25-15-101 <i>et seq.</i> , C.R.S., as amended, and its implementing regulations.
Complete Pathway	A complete surface pathway exists when a contaminant migrates in the environment from surface soil or sediment, and is detected in surface water above the respective surface water standard, background, and/or PQL at a representative surface water monitoring location. A complete subsurface pathway exists when a contaminant migrates in the environment from subsurface soil or groundwater, and is detected in groundwater above the respective surface water standard, background, and/or PQL at a representative groundwater monitoring location (Area of Concern [AOC] or Sentinel well).
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)	Commonly referred to as "CERCLA" or "Superfund," this federal statute was enacted by Congress in 1980 and was amended several times thereafter. CERCLA was designed to respond to situations involving past disposal of hazardous substances. CERCLA provides EPA the authority to clean up hazardous substance sites under "response" or "remedial" provisions of the National Contingency Plan (NCP) and other implementing regulations. 42 U.S.C. §§ 9601 <i>et seq.</i>
Contaminant of Concern (COC)	A contaminant or a chemical that poses potential public health risks specific to the Rocky Flats Site. Potential contaminants of concern (PCOCs) are all chemicals that have been detected at the site. Only those contaminants retained for the risk assessment are referred to as COCs.
Corrective Action Decision (CAD)	Document required under RFCA by CDPHE and RCRA/CHWA to document the final cleanup decision for Rocky Flats.
Corrective Measures Study (CMS)	A study under RCRA/CHWA to identify and evaluate potential cleanup alternatives at a corrective action site. The CMS is usually done with the RCRA Facility Investigation Study. Together they are usually referred to as the RFI/CMS.
Decontaminate	To remove or reduce radioactive or hazardous contamination from facilities, equipment, or soil by washing, heating, chemical action, or other technique.
Ecological Contaminant of Potential Concern	Chemicals that have been detected and that have the potential to pose risk to ecological receptors at the site. Ecological contaminants of interest (ECOs) are all chemicals that have been detected at the site. Only those contaminants retained for risk characterization are referred to as ECOPCs.
Environmental Covenant	A mechanism created by Colorado law to implement and enforce land use restrictions that are required under an environmental cleanup. The covenant is recorded in the county land records. The covenant's restrictions may be enforced against current and subsequent owners and users of the affected property. Sections 25-15-317 <i>et seq.</i> , C.R.S.

Exposure Unit (EU)	An EU is the area over which long-term risks to the chosen receptors (both human health and ecological) were assessed. The size of the EU varies with the land use and receptor activities, and represents the area over which a receptor ranges. EUs were designated based on reasonable aggregations of common source areas, potential contaminant release patterns, hydrological systems, habitat (for assessing ecological risk), and functional areas (for assessing human health risk). Rocky Flats was divided into 12 EUs for the Comprehensive Risk Assessment.
Feasibility Study (FS)	A study under CERCLA to identify and evaluate potential cleanup alternatives at a CERCLA site. The FS is usually done with the Remedial Investigation study. Together they are usually referred to as the RI/FS.
Half Life	The time required for one-half of the radioactive isotopes in a sample to decay to radiogenic (daughter) isotopes.
Hazard Index (HI)	Is based on the summation of hazard quotients of multiple contaminants.
Hazard Quotient (HQ)	Non-cancer health effects are calculated by dividing the exposure estimate (intake of a chemical) by the noncancer toxicity criterion (a chemical's reference dose [RfD] for human receptors or toxicity reference value [TRV] for ecological receptors). The ratio between the two levels is called a hazard quotient. An HQ less than 1 indicates that people are unlikely to have adverse effects. An HQ is based on a single contaminant.
Hazardous Substance	A broad category of substances regulated under CERCLA that includes substances designated under the Clean Water Act (toxic pollutants), the Solid Waste Disposal Act (hazardous wastes), the Clean Air Act (hazardous air pollutants), the Toxic Substances Control Act (substances for which §7 actions were taken), or CERCLA itself, but does not include petroleum products or natural gas. 42 U.S.C. §9601(14).
Hazardous Waste	A category of waste regulated under RCRA or CHWA. To be considered hazardous, a waste under RCRA must be a solid waste and must exhibit at least one of four characteristics described in 40 CFR 261.20 through 40 CFR 261.24 (i.e., ignitability, corrosivity, reactivity, or toxicity) or be specifically listed by EPA in 40 CFR 261.31 through 40 CFR 261.33. Hazardous waste does not include source, special nuclear, or by-product materials as defined by the AEA, nor material contained in point source discharges regulated under the Clean Water Act.
Individual Hazardous Substance Site (IHSS)	A name given to a discrete area of known or suspected contamination at Rocky Flats.
Industrial area (IA)	The roughly 300 acres at the center of Rocky Flats where most of the weapons production took place. It contained 800 structures plus infrastructure such as electrical, water, and wastewater systems. Its cleanup is regulated by CDPHE through the RFCA.
Institutional Controls (ICs)	Non-engineered instruments such as administrative and/or legal controls that minimize the potential for human exposure to contamination by limiting land or resource use.
Integrated Monitoring Plan (IMP)	A plan updated annually to describe the environmental monitoring by medium and uses for the data collected at Rocky Flats.
Maximum Contaminant Level (MCL)	Under the Safe Drinking Water Act, the maximum permissible level of a contaminant in water delivered to any user of a public water system.
National Contingency Plan (NCP)	The federal regulation that guides the cleanup of sites under CERCLA. 40 CFR Part 300.
National Priorities List (NPL)	EPA's list of priority hazardous waste sites identified for possible long-term remedial action under CERCLA. The list is based primarily on the score a site receives from the Hazard Ranking System. Rocky Flats was listed on the NPL in 1989.
Non-Aqueous Phase Liquid (NAPL)	Organic compounds or mixtures of such compounds that do not mix with water. A NAPL that is lighter than water is called light non-aqueous phase liquid (LNAPL) or a floater. A NAPL that is heavier than water is called dense non-aqueous phase liquid (DNAPL) or a sinker.
Operable Unit (OU)	A term given to large areas of Rocky Flats where remediation may be focused by grouping IHSSs into a single management unit. Rocky Flats was originally divided into 16 OUs.
Picocurie (pCi)	A basic unit of radioactivity, the curie (Ci), was defined as the number of disintegrations that would be seen from a gram of radium in one second. A "picocurie" is one-trillionth of a curie. The same mass (one gram) of other radioactive elements may have an activity higher or lower than one curie.

Plutonium (Pu)	A man-made silvery metal that is two times denser than lead, has 15 known isotopes with masses ranging from 232 to 246, and emits alpha radiation. Plutonium is used almost exclusively for nuclear fuels and nuclear weapons. It is "pyrophoric" or spontaneously combustible; the chemical reaction in Pu itself supplies enough heat to start a fire spontaneously without a flame or spark; it can burn when exposed to oxygen. It is also toxic and fissile. Plutonium-239, which represents most of Rocky Flats' Pu, has a half-life of 24,360 years.
Point of Compliance (POC)	Location that is monitored for compliance with federal and state water quality standards.
Practical Quantitation Limit (PQL)	PQL is the lowest concentration that can be reliably measured within specified limits of precision and accuracy for a specific laboratory analytical method during routine laboratory operating conditions.
Preliminary Remediation Goals (PRGs)	PRGs are chemical specific concentration goals for individual chemicals for specific medium and land use combinations at CERCLA sites. At Rocky Flats, PRGs are risk-based calculations that set concentration limits using carcinogenic and/or noncarcinogenic toxicity values under specific exposure conditions.
Radioactive	Of, caused by, or exhibiting radioactivity.
Radioactivity	Spontaneous change in an atom by emission of charged particles (ionizing radiation) and/or gamma rays.
RCRA Facility Investigation (RFI)	An investigation to collect data necessary to adequately characterize a RCRA/CHWA corrective action site, assess the risks to human health and the environment, and to support the development of remedial alternatives. The RFI is usually done with the Corrective Measures Study (CMS). Together they are usually referred to as the RFI/CMS.
Record of Decision (ROD)	Document required under RFCA by EPA and CERCLA to document the final cleanup decision for Rocky Flats.
Remedial Action Objective (RAO)	Contaminant-specific goals for the final response action. RAOs are based on exposure pathway scenarios, ARARs, and target risk levels.
Remedial Investigation (RI)	An investigation to collect data necessary to adequately characterize a CERCLA site, assess the risks to human health and the environment, and to support the development and evaluation of remedial alternatives. The RI is usually conducted with the Feasibility Study (FS). Together they are usually referred to as the RI/FS.
Resource Conservation and Recovery Act (RCRA)	A federal law enacted in 1976 to address solid waste and the treatment, storage, and disposal of hazardous waste. 42 U.S.C. §§ 6901-6992k.
Rocky Flats Cleanup Agreement (RFCA)	The legally binding agreement between DOE, EPA, and CDPHE to accomplish the required cleanup of radioactive and other hazardous substances contamination at Rocky Flats.
Sentinel Wells	Wells that are typically located near downgradient contaminant plume edges, in drainages, and downgradient of existing groundwater treatment systems. These wells will be monitored to identify changes in groundwater quality.
Solid Waste Management Unit (SWMU)	A term used under RCRA and CHWA that means any discernible unit at which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous waste. Various areas at Rocky Flats were originally designated as SWMUs and were later included under IHSSs.
Special Nuclear Material (SNM)	Plutonium, uranium enriched in the isotope 233 or in the isotope 235, and any other material determined to be SNM pursuant to the Atomic Energy Act, or any material artificially enriched by any of the foregoing; but does not include source material.
Transuranic Waste	Waste contaminated with alpha-emitting transuranium radionuclides (elements that have an atomic number higher than 92 [uranium]) with half-lives greater than 20 years and concentrations greater than 100 nanocuries per gram.
Uranium (U)	A radioactive, metallic element with the atomic number 92 that is the heaviest naturally occurring element. Uranium has 14 known isotopes, of which uranium-238 is the most abundant in nature. Uranium-235 is commonly used as a fuel for nuclear fission.